Piston-cylinder device with position sensing means.

The invention relates to a pressure medium activated piston-cylinder device with a piston position indicating device which comprises a magnetic activating element on the piston and a sensor means carried on the cylinder barrel.

According to a common technique indication of piston positions in a cylinder bore is accomplished by a device comprising a magnetic activating element mounted on the piston and one or more single-point sensors adjustably mounted on the cylinder barrel. A problem concerned with this known technique is the difficulty to obtain a quick and easy setting of the sensors in the cylinder barrel. These sensors have to be moved individually and locked in their intended positions by manual operation which is rather tricky and time consuming. Another problem is that the number of indicated positions is limited to a few points which is limiting to the piston action control possibilities.

A further problem concerned with this known technique is to accomplish a compact piston-cylinder device where the position sensing means, including signal treating electronic components, do not add to the outer dimensions of the device but are confined within the outer dimensions of a standard type piston-cylinder device and safely protected from inter alia mechanical damage.

In US Patent No. 6,351,117 there is described an alternative way of obtaining position indication in a piston-cylinder device by means of a magnetically activated magnetostrictive transducer using electric pulses for measurement. The transducer is mounted concentrically in the cylinder bore and extend from one of the cylinder end walls into the piston/piston rod, whereas the activation magnet is mounted on the piston. This is, however, a rather

awkward location of the transducer, because it not only requires an expensive specially designed piston/piston rod and cylinder end wall but the transducer is difficult to get to in case of maintenance and replacement. A problem arising at piston-cylinder device applications is to find a way to locate the transducer without complicating the cylinder design compared to the above related common technique.

One solution to the transducer location problem is described in US 5,514,961 where the transducer is located in a bore in the cylinder barrel parallel to the cylinder bore. An evaluation device including electronic components is mounted in an extension of the cylinder barrel. This means not only that a specially designed cylinder barrel with a drilled extra bore for the sensor has to be used, but also that the arrangement of the electronic evaluating device adds to the length of the cylinder.

The above identified problems related to prior art piston-cylinder devices with position sensing transducers are solved by the invention in that a piston-cylinder device is created wherein a standard type of extruded aluminium alloy barrel is used and wherein both the position sensing transducer and the circuit board electronics are fitted without any special machining of the cylinder barrel and without adding to the outer dimensions of the device. Instead, the device according to the invention may preferably incorporate a standard type cylinder barrel meeting the international standard ISO VDM specifications.

A preferred embodiment of the invention is described below with reference to the accompanying drawing.

On the drawing
Fig. 1 shows a longitudinal section through a piston-cylinder device according to the invention.

Fig. 2 shows a side view of the device in Fig. 1.
Fig. 3 shows a cross section of the device in Fig. 1.

The piston-cylinder device illustrated in the drawings comprises a cylinder barrel 10 with a cylinder bore 11 and two opposite end walls 12 and 13, a piston 14 movably guided in the cylinder bore 11 and a piston rod 15 extending out of the cylinder barrel 10 via an opening in one of the end walls 12. The cylinder barrel 10 is of a standard type consisting of an extruded aluminium alloy body including an outer elongate cavity or groove 20. The groove 20 is formed at the extrusion process which means that no extra machining of the barrel 10 is necessary. The cylinder barrel 10 as well as the complete piston-cylinder device is dimensioned to meet the ISO VDM standard specifications.

In a common way, the cylinder barrel 10 is provided with non-illustrated connections for communication of pressure medium to and from the cylinder bore 11 as well as passages for ducting motive pressure medium to and from the ends of the cylinder bore 11 for accomplishing movement of the piston.

A position sensing and indicating device comprises an activating magnetic element 17 mounted on the piston 14 and an elongate sensor unit in the form of a magnetostrictive transducer 18 mounted in the groove 20 on the cylinder barrel 10. The transducer 18 extends over a major part of the length of the cylinder barrel 10 and is connected to electronic components on a circuit board 19. The circuit board 19 is also mounted in the groove 20.

Since the groove 20 is open to the outside of the cylinder barrel 10 the transducer 18 and the circuit board 19 have to be protected from external damage, dirt etc. This accomplished by a cover strip 21 which preferably is made

of a resinous material and which closes the groove 20 to the ambient environment.

So, the groove 20 is wide enough to comprise the circuit board 19, and adjacent the circuit board 19 there is also located a panel 25 carrying a number of LED elements 26a-d for visual indication of pre-set positions reached by the piston 14. A cable 27 extends out through the panel 25 for connecting the circuit board 19 to a remotely located programmable control unit, for instance a PC.

In operation, indications are obtained as the magnetic element 17 on the piston 14 passes certain chosen indication points on the transducer 18. These indications are shown visually via the LED elements and are used for governing the supply of pressure medium to and from the cylinder bore 11, thereby controlling the operation of the piston 14. Since this type of position indicating transducer 18 makes it possible to get indications of a large number of piston positions it is possible not only to obtain stop/start functions but also retardation ramps, for instance in the vicinity of the cylinder end walls 12,13. This makes it possible to simplify the cylinder design by omitting the adjustable flow restrictions normally built-in in the cylinder end walls 13,14.

The operation order of the micro pulse operated magnetostrictive transducer 18 is well known per se, for instance through US3,898,555, and is not described in detail in this specification.

The invention is new and makes it possible to obtain the combination of an over all compact cylinder design with well protected sensor components. Also, the invention makes it possible to accomplish a non-expensive piston-cylinder device with an advanced position sensing means by utilising

a relatively cheap standard type of extruded aluminium alloy cylinder barrel.

The position indicating points on the transducer 18 are set electronically via a remotely located computer and the electronic components of the circuit board 19. The electronics are preferably arranged so as to make possible an indication point setting according to the teach-in technique.

By locating the position transducer 18 and the electronic circuit board 19 in the groove 20 originally formed in the cylinder barrel 10 there is obtained a non-expensive and compact piston-cylinder device with over all dimensions meeting the ISO VDM standard. Also, the new device provides for a good accessibility of the transducer and the circuit board for service and replacements.